

What is claimed is:

1. A display device comprising:

a display panel having cathodes, gates and an anode, the cathodes and the gates being connected in matrix form;

electron emitters provided on each of the cathodes and capable of performing electron emission with a voltage applied only between the cathodes and the anode,

the display device being constructed to perform display by bringing pixels to dark states by applying a cut-off voltage between the cathodes and the gates to cut off electron emission from the electron emitters toward the anode; and

a control unit for controlling the operation of a display panel driving circuit in order to complete, when a display completing signal is generated, application of the cut-off voltage or a driving voltage capable of providing a particular display state, after a predetermined time passes from the moment when a potential of the anode decreases below a threshold potential capable of causing electron emission from the electron emitters with the cut-off voltage or the driving voltage capable of providing the particular display state being applied between the cathodes and the gates.

2. A display device according to claim 1, wherein the application of the cut-off voltage or the driving voltage capable of providing the particular display state between the cathodes and the gates is simultaneously performed on all pixels of the display panel.

3. A display device according to claim 1, wherein the cut-off voltage or the driving voltage capable of providing the particular display state is applied between the cathodes and the gates by supplying a scanning selecting potential to at least one row of scanning lines of the display panel while supplying a scanning non-selecting potential to the other rows of the scanning lines, and supplying modulated potentials capable of generating darkest states or a predetermined potential to all columns of modulated signal lines of the display panel in synchronism with the scanning non-selecting potential.

4. A display device according to claim 1, wherein the display panel driving circuit includes:

an anode power source circuit for supplying the anode potential;

a cathode driving circuit for driving the cathodes;

a gate driving circuit for driving the gates;  
and

a driving power source circuit for supplying a driving reference potential for generating the cut-off voltage or the driving voltage capable of providing the particular display state, to the cathode driving circuit and the gate driving circuit.

5. A display device according to claim 4, wherein the cathode driving circuit and the gate driving circuit completes the application of the cut-off voltage or the driving voltage capable of providing the particular display state, with a logic circuit driving potential supplied to the cathode driving circuit and the gate driving circuit, and subsequently the driving power source circuit completes the supply of the driving reference potential.

6. A display device according to claim 4, wherein during a period within which the application of the cut-off voltage or the driving voltage capable of providing the particular display state is completed, the anode power source circuit holds the anode at a particular potential sufficiently lower than the threshold potential capable of causing electron emission from the electron emitters with a logic

circuit driving voltage applied to the anode power source circuit.

7. A display device according to claim 4, wherein the application of the cut-off voltage or the driving voltage capable of providing the particular display state is completed after the application of an image-displaying driving voltage based on input display image data from the cathode driving circuit and the gate driving circuit to the display panel is completed.

8. A display device according to claim 1, wherein the voltages between the cathodes and the gates are made to transition to zero after the application of the cut-off voltage or the driving voltage capable of providing the particular display state is completed.

9. A display device according to claim 1, wherein the cut-off voltage or the driving voltage capable of providing the particular display state is applied between the cathodes and the gates by supplying a scanning non-selecting potential capable of applying the cut-off voltage, to either cathode lines or gate lines which serve as scanning lines in the display panel, irrespective of potentials of the other lines

which serve as modulated signal lines, or by supplying the cut-off voltage or modulated potentials capable of applying a driving voltage capable of providing the particular display state, to either cathode lines or gate lines which serve as modulated signal lines, irrespective of potentials of the other lines which serve as scanning lines.

10. A display device according to claim 1, wherein modulated potentials to be supplied to either one of cathode lines or gate lines which serve as modulated signal lines in the display panel are potentials selected from three or more levels, two or more of the modulated potentials being potentials each of which generates a driving voltage capable of emitting electrons by being supplied in synchronism with a scanning selecting potential, one of the modulated potentials being a potential which generates the cut-off voltage.

11. A display device according to claim 1, wherein each of the electron emitters is a fibrous nanostructure made of a semiconductor or a conductor or a nanostructure mainly containing carbon.

12. A display device according to claim 11, wherein the nanostructure includes at least one kind

selected from the group consisting of carbon nanotubes, graphite nanofibers, amorphous carbon, carbon nanohorns, graphite, diamond-like carbon, diamond and fullerene.

13. A driving and controlling method for a display device which includes:

a display panel having cathodes, gates and an anode, the cathodes and the gates being connected in matrix form;

electron emitters provided on each of the cathodes and capable of performing electron emission with a voltage applied only between the cathodes and the anode,

the display device being constructed to perform display by bringing pixels to dark states by applying a cut-off voltage between the cathodes and the gates to cut off electron emission from the electron emitters toward the anode,

the driving and controlling method comprising:

an anode potential supply stopping step of decreasing, when a display completing signal is generated, a potential of the anode to a potential below a threshold potential capable of causing electron emission from the electron emitters with the cut-off voltage or the driving voltage capable of providing a particular display state being

applied between the cathodes and the gates; and

an application stopping step of stopping the application of the cut-off voltage or the driving voltage capable of providing the particular display state, after a predetermined time passes from the moment when the anode potential supply stopping step is performed.

14. A driving and controlling method for a display device according to claim 13, wherein the driving power source circuit holds the anode at a potential sufficiently higher than the threshold potential capable of causing electron emission from the electron emitters, and stops the application of the image-displaying driving voltage based on the input display image data from the cathode driving circuit and the gate driving circuit to the display panel,

then performs the anode potential supply stopping step and, during an end period of the anode potential supply stopping step, the cathode driving circuit and the gate driving circuit continue to apply the cut-off voltage or the driving voltage capable of providing the particular display state between the cathodes and the gates, with a logic circuit driving potential supplied to the cathode driving circuit and the gate driving circuit,

and subsequently stops the application of the

cut-off voltage or the driving voltage capable of providing the particular display state between the cathodes and the gates, in the state of holding the anode at a particular potential sufficiently lower than the threshold potential capable of causing electron emission from the electron emitters.